GURU GHASIDAS VISHWAVIDYALAYA
BILASPUR (C.G.)

(A Central University)

Koni, Bilaspur-495009, C.G (India)

OUTCOME BASED EDUCATION
WITH
CHOICE BASED CREDIT SYSTEM (CBCS)

MASTER OF TECHNOLOGY
IN
WATER RESOURCES AND ENVIRONMENTAL ENGINEERING

COURSE STRUCTURE AND SYLLABI

M. Tech. Regular Two Year Degree Program
(Effective from the Academic Year 2025-26)

DEPARTMENT OF CIVIL ENGINEERING
SCHOOL OF STUDIES OF ENGINEERING & TECHNOLOGY
GGV, BILASPUR, C.G. (INDIA)

DEPARTMENT OF CIVIL ENGINEERING
SCHOOL OF STUDIES OF ENGINEERING & TECHNOLOGY, GGV, BILASPUR, C.G. (INDIA)

SCHEME OF EXAMINATION

M.TECH. WATER AND ENVIRONMENTAL ENGINEERING

M.Tech. I-Semester

Sl.	Course Type/ Code	Subjects	Periods/Week			Evaluation			Credits
			L	T	P	IA	ESE	Total	
1.	CWPATT1	Physico-Chemical Processes in Water and Wastewater Treatment	3	0	0	40	60	100	3
2.	CWPATT2	Irrigation Technology and Water Management	3	0	0	40	60	100	3
3.	CWPATP1 CWPATP2 CWPATP3	Elective – I 1. Industrial Pollution Control 2. Air Pollution and Control 3. Environmental Impact Assessment	3	0	0	40	60	100	3
4.	CWPATP4 CWPATP5 CWPATP6	Elective – II 1. Optimization Techniques with Water Resources Engineering Applications 2. Design of Hydraulic Structures 3. Groundwater Hydrology	3	0	0	40	60	100	3
5.	CWPATP7 CWPATP8 CWPATP9	Elective – III 1. Water Supply Systems 2. Spatial Modelling and Assessment 3. Water Resources Systems Analysis	3	0	0	40	60	100	3
6.	CWPALT1	Physico-chemical and biological Process Laboratory	0	0	3	30	20	50	2
7.	CWPATC1	Research Methodology and IPR	2	0	0	-	50	50	2
Total			17	0	3	230	370	600	19

M.Tech. II-Semester

Sl.	Course Type/ Code	Subjects	Periods/Week			Evaluation			Credits
			L	T	P	IA	ESE	Total	
1.	CWPBTT1	Solid and Hazardous Waste Management	3	0	0	40	60	100	3
2.	CWPBTT2	Open Channel Hydraulics	3	0	0	40	60	100	3
3.	CWPBTP1 CWPBTP2 CWPBTP3	Elective – IV 1. Process and Hydraulic Design of Water and Wastewater Systems 2. Applied Hydrology 3. Flood Estimation and Control	3	0	0	40	60	100	3
4.	CWPBTP5 CWPBTP6 CWPBTP7	Elective – V 1. Advance Hydraulic Engineering 2. Spatial Data Collection and Analysis 3. Introduction to CFD	3	0	0	40	60	100	3
5.	MSPBTO1 IPPBTO2 IPPBTO3 CWPBTO4 MEPBTO5 CHPBTO6 ECPBTO7 MCPBTO8 ITPBTO9	Open Elective 1. Business Analytics 2. Industrial Safety 3. Operations Research 4. Cost Management of Engineering Projects (Otherthan Civil Engg.) 5. Composite Materials 6. Waste to Energy 7. IoT 8. MOOCs 9. Software Engineering Techniques	3	0	0	40	60	100	3
6.	CWPBLT1	Computer Application in Water Resources lab	0	0	3	30	20	50	2
7.	CWPBPT1	Mini Project	0	0	4	30	20	50	2
8.	ELPBTX1 PEPBTX2 CWPBTX3 LAPBTX4	Audit Course/Value AddedCourse 1. English for Research PaperWriting 2. Stress Management by Yoga 3. Disaster Management 4. Constitution of India	2	0	0	40	60	100	2
Total			17	0	07	300	400	700	21

Note: Under MOOCs the students have to opt any subject other than Civil Engineering from NPTEL/UGC SWAYAM

M.Tech. III-Semester

Sl.	Course Type/ Code	Subjects	Periods/Week			Evaluation			Credits
			L	T	P	IA	ESE	Total	
1.	CWPCPT1	Dissertation Stage–I	0	0	28	100	100	200	14
Total			0	0	28	100	100	200	14

M.Tech. IV-Semester

Sl.	Course Type/ Code	Subjects	Periods/Week			Evaluation			Credits
			L	T	P	IA	ESE	Total	
1.	CWPDPT1	Dissertation Stage–II	0	0	32	100	200	300	16
Total			0	0	32	100	200	300	16

Total Credits for the Program = 19 + 21 +14 +16 = 70

M. Tech. Water Resources and Environmental Engineering

Semester-I

Subject:	**Physico-Chemical Processes in Water and Wastewater Treatment**			**Credits**	
Type:	Core-I	L	T	P	Total
Teaching Scheme:	Lectures: 3 hours/week	3	0	0	3

Course Objective: The course is aimed

1. To provide students with the knowledge of different Physico-chemical processes related to water and wastewater treatment.
2. Comprehend the modes of operation and engineering application of various Physico-chemical processes.
3 Learn the design implementation of the Physico-chemical processes in water and wastewater treatment plant.

Course outcomes:

1 Know different Physico-chemical processes related to water and wastewater treatment.
2 Comprehend the modes of operation and engineering application of various Physico-chemical processes.
3 Learn the design implementation of the Physico-chemical processes in water and wastewater treatment plant.

Syllabus Contents:

- **Coagulation and Flocculation:** Stability of colloids, destabilization, transport of colloidal particles, design
- **Sedimentation:** Discrete and flocculent suspensions, clarifier configuration, design, tube/plate settlers
- **Chemical precipitation:** Basic principle, OH^-, CO_3^{2-} and S^- precipitation, water softening Applications
- **Filtration:** Configurations/classifications, mechanism, filter hydraulics and design of filter bed
- **Membrane processes:** Membranes, Reverse osmosis, ultra-filtration, electrodialysis, principles and application
- **Adsorption:** Mechanism, equilibria, kinetics, contacting systems and modes of operation, design
- **Ion Exchange:** Exchange processes, exchange materials, equilibria, modes of operation and application, design
- **Disinfection:** pathogens and indicator organisms, disinfectants, disinfection processes, factors affecting disinfection

References:

- Walter J Weber Jr. Physicochemical Processes for Water Quality Control, John Wiley and Sons
- Davis and Cornwel, “Introduction to Environmental Engineering”, McGraw Hill Publishers
- Peavy, Rowe and Tchobanoglous, “Environmental Engineering”, McGraw Hill Publishers

Subject:	**Irrigation Technology and Water Management**	**Credits**			
Type:	Core-II	L	T	P	Total
Teaching Scheme:	Lectures: 3 hours/week	3	0	0	3

Course Objectives: The course is aimed

1 To understand the Types & Techniques of Irrigation.

2 To develop the basic understanding of Soil and Land Management in Agriculture.

3 To understand the Crop requirements and irrigation scheduling.

4 To learn the Water conveyance and computing the capacity of canals.

5 To learn the Reclamation of Water Logged and Saline Soils.

Course outcomes: At the end of the course, students will be able to

1 To have an understanding about Types & Techniques of Irrigation

2 To have an understanding about Soil and Land Management in Agriculture.

3 To have an idea about Crop requirements and irrigation scheduling.

4 Ability to analyse and calculate the capacity of canals.

5 To have an idea Reclamation of Water Logged and Saline Soils.

Syllabus Contents:

- Introduction: Types & Techniques of Irrigation including advanced techniques, Present situation of irrigation in India Soil-Moisture Irrigation Relationship, Estimating depth and frequency of irrigation.
- Soil and Land Management in Agriculture: classification and surveys-land capability farm development, grading-equipment, land management techniques.
- Crop requirements and irrigation scheduling: Major Indian crops times of sowing and harvesting –critical periods of growth moisture stress, Duty & delta of crops, Irrigation scheduling,
- Consumptive use of Crop- Blanney-Criddle, Thornth wait penman, Christiansen methods, Water-use efficiency, scope of computerization in irrigation.
- Water conveyance Computing the capacity of canals, Losses in water canals, Distribution of water into the fields through water courses, Lined canals.
- Reclamation of Water Logged and Saline Soils: Glances of water logging- design of surface and subsurface drains, Saline and alkaline lands reclamation and management of Salt affected lands.

References:

- Modi. P. N., "Irrigation, Water Resources & Water Power Engineering", Standard Publishers, New Delhi.
- Punmia B. C., Pande Ashok kumar and Jain Arun kumar, "Irrigation and water power engineering", Laxmi Publications Pvt. Ltd.
- Chaturvedi M.C., "Water Resources Systems Planning and Management", Tata McGraw Hill. NY.
- Linsley, R. K.and Frazinini, J. B., "Water Resources Engineering", 2nd Ed. McGraw Hill, NY
- James L.D and Lee R.R., "Economics of Water Resources Systems Planning, McGraw Hill. NY

Subject:	**Industrial Pollution Control**	**Credits**			
Type:	Program Elective (I)	L	T	P	Total
Teaching Scheme:	Lectures: 3 hours/week	3	0	0	3

Course Objectives: The course is aimed

1 To provide students with the knowledge of different industrial processes and pollution control.

Course outcomes: At the end of the course, students will be able to

1 Know about water pollution and control.

2 Become familiar with different industrial pollution and control.

3 Learn about management of hazardous waste.

Syllabus Contents:

- **Water pollution control:** Wastewater quality parameters; Effect of discharge of industrial wastewaters on streams, land and environment; importance and scope, problem involved in water treatment; Variation and quality of industrial wastewater; Indian Standards for discharge of treated wastewaters on land, into municipal sewer and natural watercourses;

- **Sampling of wastewaters**–Wastewater survey, sampling and preservation, Representative samples, Grab and composite samples; Approach and minimization of waste generation;

- **Treatment options-** Equalization and proportioning, neutralization, floatation, physicochemical process applied in industrial wastewater treatment, Case studies Process flow diagrams, characteristics and treatment of various industrial wastewater: pulp and paper, textile, tannery, distillery, electroplating, refinery etc

- **Hazardous Waste Management**: Definition and identification of hazardous wastes; sources and characteristics; Regulatory framework in India; Hazardous waste treatment technologies - physical, chemical and thermal treatment of hazardous waste; Hazardous waste landfills - site selection, design and operation – remediation of hazardous waste disposal sites, CPCB guidelines

- **Biomedical waste:** Biomedical waste generation, location, land and cover area, equipment infrastructure, record, inventories, segregation, transport and treatment, CPCB Guide lines

References:

- Metcalf & Eddy “Wastewater Engineering –Treatment and Reuse”, Tata McGraw Hill Publishers.
- Davis and Cornwel, “Introduction to Environmental Engineering”, McGraw Hill Publishers
- Peavy, Rowe and Tchobanoglous, “Environmental Engineering”, McGraw Hill Publisher

Subject:	**Air Pollution and Control**	**Credits**			
Type:	Program Elective (I)	L	T	P	Total
Teaching Scheme:	Lectures: 3 hours/week	3	0	0	3

Course Objectives: The course is aimed

1 To familiarize students with air pollution and its control methods.

Course outcomes: At the end of the course, students will be able to

1 Know about the fundamentals of air pollution, its sources, types and global impact.

2 Learn about air pollution monitoring and analysis.

3 Become familiar with National & International air emission standards and control laws.

4 Learn about air pollution control methods.

Syllabus Contents:

- **Introduction to the course:** Atmosphere Air pollution episodes Air pollution**:** sources, types, chemical transformation and effects on biosphere and environment
- **Air pollution monitoring and analysis**: National & International air emission standards; air pollution emission inventory; emission factor; air quality index; air pollution control laws
- **Introduction to air pollution meteorology:** Air pollution dispersion, transportation, Air Quality Modelling: meteorological parameters, simple box and Gaussian type model for point, area and line sources
- **Air pollution control:** SO_2, NO_2, particulates, Hydrocarbons.; Urban air pollution, Vehicular air pollution, control: Indoor air pollution
- **Global effects of air pollution:** Greenhouse effects, acid rain and ozone layer depletion; international agreements for mitigating global air pollution effects.

References:

- Noel De Nevers Air Pollution Control Engineering, McGraw-Hill.
- C. David Cooper and F.C. Alley Air Pollution Control – A Design Approach, MEDTECH.
- Kenneth Wark, Cecil F. Warner, Wayne T Davis Air Pollution – Its Origin and Control, PEARSON

Subject:	**Environmental Impact Assessment**			**Credits**	
Type:	Program Elective (I)	L	T	P	Total
Teaching Scheme:	Lectures: 3 hours/week	3	0	0	3

Course Objectives: The course is aimed

1 To introduce basic, Identify the need to assess and evaluate the impact environment.

2 To introduce major principles of environmental impact assessment

Course outcomes: At the end of the course, students will be able to

1 Able to explain the concepts about the Environmental Impact Assessment (EIA).

2 Able to evaluate the subjects which must be considered in EIA projects.

3 Able to overview of assessing risks posing threats to the environment

4 Able to access different case studies/examples of EIA in practice

5 Able to prepare EIA reports

Syllabus Contents:

- **Introduction:** Environment and its components, Concept of Ecological imbalances, carrying capacity and sustainable development

- **Legal, Policy & Regulatory framework**
  Legislative and environmental clearance procedures in India and other countries, Impact Assessment Methodologies? Matrices, overlays, network analysis

- **EIA Procedure** - Scoping & Screening Evolution of environmental impact assessment (EIA), Current screening process in India. A step-by-step procedure for developing EIA, Elements of Environmental Analysis.

- **EIA Methodologies and Impact Identification**
  Public consultation, Post monitoring, Data collection for Air Quality Impact analysis, Environmental health impact assessment, Environmental risk analysis, Economic valuation methods, Cost-benefit analysis

- **Prediction & Assessment of Impacts on the Water and Soil Environment**
  Water Quality Impact Analysis and energy impact analysis, Impact Analysis of Water resources projects, Prediction & Assessment of Impacts on the Soil Environment

- **EIA Case Studies, EIA Reporting & Review of EIA**
  Case studies of Industrial and other EIA projects, Brief introduction about Environment legislation and Environmental Audit, Practical applications of EIA methodologies.

References:

- Environmental Impact Assessment by C.W. Canter
- Environmental Impact Assessment for Developing Countries: Asit K. Biswas
- A Chadwick, Introduction to Environmental Impact Assessment, Taylor & Francis, 2007
- Larry W. Canter, Environmental Impact Assessment, McGraw Hill Inc. Singapore, 1996

Subject:	**Optimization Techniques with Water Resources Engineering Applications**	**Credits**			
Type:	Program Elective (II)	L	T	P	Total
Teaching Scheme:	Lectures: 3 hours/week	3	0	0	3

Course Objectives: The course is aimed

1 Formulate water resources and civil engineering problems as optimization models.

2 Apply LP/NLP/metaheuristics to water distribution, flood control, and infrastructure design.

3 Use Python/MATLAB/HEC-RAS for water-related optimization.

Course outcomes: At the end of the course, students will be able to

1 Identify and formulate water resources and civil engineering problems as mathematical optimization models.

2 Apply linear programming, nonlinear programming, and metaheuristic methods to solve problems related to water distribution systems, flood control, and infrastructure design.

3 Demonstrate proficiency in using computational tools such as Python, MATLAB, and HEC-RAS to implement and analyze optimization models in water resources engineering.

Syllabus Contents:

- **Problem Formulation** Design Vector, Design Constraints, Constraint Surface, Objective Function, Objective Function Surfaces, Classification of Optimization Problems, Single-Variable Optimization, Multivariable Optimization with No Constraints, with Equality Constraints and with Inequality Constraints
- **Linear Programming (LP)** Simplex Method, Application to structural optimization.
- **Nonlinear Programming (NLP)** One-Dimensional Minimization Methods, Unconstrained Optimization Techniques, Constrained Optimization Techniques.
- **Optimal Control** Calculus of Variations, Optimal Control Theory, Optimality Criteria Methods, optimization of sections, steel and concrete structures, framed structures, bridge structures.
- **Modern Methods** Genetic Algorithms, Simulated Annealing, Particle Swarm Optimization, Ant Colony Optimization, Optimization of Fuzzy Systems. Artificial Intelligence and Artificial Neural Networks based approaches for structural optimization problems.

References:

- Optimization in Civil Engineering – Singiresu S. Rao.
- Water Resources Systems Analysis – Loucks & van Beek.
- Optimization in Water Resources – Vedula & Mujumdar.
- J.S. Arora, introduction | to Optimum Design, Elsevier, 2nd Edition, 2004.

Subject: **Design of Hydraulic Structures**

		Credits			
Type:	Program Elective (II)	L	T	P	Total
Teaching Scheme:	Lectures: 3 hours/week	3	0	0	3

Course Objectives: The course is aimed

1 Recognise the different types of dams, identify its purpose and function and to select the most appropriatedam.

2 To introduce and give explanation the Principles of Design of Hydraulic Structures.

3 To develop understanding for Analysis of gravity dam.

4 To develop understanding about Earth dam and stability analysis.

5 To introduce the importance of Spillways and energy dissipation systems

Course outcomes: At the end of the course, students will be able to

1 Define different types of dams.

2 Describe the Principles of Design of Hydraulic Structures.CO3 Explain the concept of Gravity Dams.

3 Explain the concept of Earth dams and its stability analysis.

4 Describe the concept of spillways and energy dissipation systems.

5 Define different types of dams.

Syllabus Contents:

- Introduction - Classification of dams, Gravity dams, Earth dams, Arch dam, Buttress dam, Steel dams, Timber dams, selection of site for dam, selection of type of dam, investigations of dam sites, Engineering surveys, Geological investigations, Types of hydropower plants, site selection for power plant, General arrangement of a hydropower project.
- Principles of Design of Hydraulic Structures - Hydraulic structures on permeable foundations, Theories of subsurface floor, Khosla's method of independent variables, Exit gradient, Location of Hydraulic jump, water surface profiles, scour due to subsurface flow, Design Principles, Energy dissipation principles.
- Gravity Dams - Types of storage head works, Forces acting on gravity dams, Analysis of gravity dams, Profile of a gravity dam, Finite Element Method, Design of gravity dam, joints in gravity dam, Galleries in gravity dam, Adits and shafts, Construction of gravity dam, Foundation Grouting, Instrumentationof gravity dams.
- Earth dams - Types of earth dams, Causes of failure of earth dams, Seepage analysis, phreatic line, flow net construction, criteria for safe design of gravity dams, typical cross sections of earth dams, Stability analysis, Seepage control, and design of filters.
- Spillways and energy dissipation systems - Essential requirements of spillways, Required spillway capacity, component parts of spillway, Types of spillways, Design of Ogee spillway, Design of shaft spillway,Design of siphon spillway, Design of stilling basins. Hydropower structures - Storage power plant, Runoff River plant, Pumped storage plant, Water conveyance systems, Tunnels and Penstocks, Gates, Surge tanks, Power house layout.

References:

- Golze, A. R., Handbook of Dam Engineering, Von Rostrand Reinhold Co., 1977Sharma, H.D., Concrete Dams, CBIP Publication, 1998.
- Siddiqui, I H, Dams and Reservoirs: Planning, Engineering, Oxford University Press, USA, 2009.
- Novak, P., Moffat, A. I. B., Nalluri, C and Narayan, R., Hydraulic Structures, Taylor & Francis, 2006.
- Modi P.M., Irrigation Water Resources and Hydropower Engineering, Standard Publishing Company, NewDelhi, 2000.
- Arora K.L. Irrigation Water Resources Engineering, Standard Book Publishing Co., Delhi, 1996.

Subject:	**Groundwater Hydrology**	**Credits**			
Type:	Program Elective (II)	L	T	P	Total
Teaching Scheme:	Lectures: 3 hours/week	3	0	0	3

Course Objectives: The course is aimed

1 An ability to apply knowledge of mathematics, science, and engineering to groundwater flow problems.
2 An ability to identify, formulate, and solve groundwater engineering problems.
3 An ability to communicate effectively, understand economic, environmental, social, and sustainability issues

Course Outcomes: At the end of the course, students will be able to

1 Apply knowledge of mathematics, science, and engineering to groundwater flow problems.
2 Identify, formulate, and solve groundwater engineering problems.
3 Communicate effectively, understand economic, environmental, social, and sustainability issues

Syllabus Contents:

- Fundamentals of Groundwater Flow: Occurrence of Ground Water, Vertical Distribution of G.W.
- Darcy's Law, Permeability, Porosity, Anisotropic Aquifers, Differential equations of G.W. flow.
- Potential Flow: Flownets, Boundary conditions, Flow-net construction for confined & unconfined flow systems.
- Mechanics of Well Flow: Steady & unsteady flow in confined & unconfined aquifers, Leaky aquifers, Partial penetration of wells, Multiple well systems, Boundary effects & method of images. Characteristics Well Loses.
- Ground water Modelling: Sand Tank, Heleshaw, Electrical analogous models, Finite Element/Difference models, Analytical models, Basics of conformal mapping, Schwarz-
- Christoffel transformation, Zhukovsky's function and velocity hodograph.
- Ground Water Development and Management: Design of wells, construction of wells, Well Development, Artificial recharge,
- Conjunctive use, Salinity of G.W., Ground water pollution, Infiltration galleries.
- Rainwater Harvesting (Recharge to Aquifers), Groundwater mapping and assessment.

References:

- De Weist "Geohydrology" Wiley
- Harr, M.E. "Groundwater and Seepage" Dover Publications Inc., New York
- Pinder, G.F., and Celia, M.A. "Subsurface Hydrology" Wiley -Interscience
- Polubarinova- Kochina, P. Ya. "Theory of Ground Water Movement" Princeton University Press
- Todd, D.K. "Groundwater Hydrology" Wiley India

Subject:	**Water Supply Systems**	**Credits**			
Type:	Program Elective (III)	L	T	P	Total
Teaching Scheme:	Lectures: 3 hours/week	3	0	0	3

Course Objectives: The course is aimed

1. To provide knowledge of raw water intake structures, screening, and aeration processes, focusing on design considerations and applications in water treatment systems.
2. To introduce the components and hydraulics of water distribution systems, including pipeline networks, pump systems, and methods of network analysis and simulation.
3. To study the dynamics of unsteady flow and hydraulic transients in distribution systems, with emphasis on water hammer phenomena and transient control techniques.

Course outcomes: At the end of the course, students will be able to

1. Students will understand the principles of raw water intake design, screening mechanisms, and aeration methods, and their applications in water distribution systems.
2. Students will acquire the ability to analyze and simulate hydraulic performance of pipelines and pipe networks using methods such as Hardy Cross and EPANET software, and design solutions for multi-reservoir systems and branching pipelines.
3. Students will develop the skills to analyze hydraulic transients in distribution systems, calculate water hammer pressures, and apply control measures to mitigate transient effects.

Syllabus Contents:

- Raw water Intake, screening, and aeration- types of intake structures, intake-site selection,
- Intake design considerations, coarse screen or trash rack, fine screen, micro strainer, types of aeration and application of aeration.
- Components of water distribution systems,
- Hydraulics of pipelines and pipe networks- basic equations for study flow, pumps in pipe lines-pump characteristics, pipeline with pump,
- Culverts, pipelines connecting reservoirs- pipes in series, pipes in parallel,
- Three reservoir system; pipe network systems- conservation laws, network equations, network simulations-Hardy Cross pipe network problem,
- Linear method of pipe network analysis, branching pipe lines,
- Municipal water distribution system, unsteady flow, generalized pipe system simulation models using EPANET software.
- Hydraulic transients in distribution system- steady state flow in a pipe, water hammer condition, wave speed and pressure, control of hydraulic transients.

References:

- Syed R. Qasim, Water Works Engineering, Ptrantice-Hall of India Pvt. Ltd., New Delhi, 2004.
- Ralph A. Wurbs, Water Resources Engineering, Ptrantice-Hall of India Pvt. Ltd., New Delhi, 2002.
- Larry W. Mays, Water Resources Engineering, John Wiley & Sons, Inc., 2001.
- Gurucharan Singh, Water Supply and Sanitary Engineering, Standard Publishers Distributors, New Delhi.

Subject:	**Spatial Modelling and Assessment**	**Credits**			
Type:	Program Elective (III)	L	T	P	Total
Teaching Scheme:	Lectures: 3 hours/week	3	0	0	3

Course Objectives: The course is aimed

1 To introduce fundamental concepts of geospatial modeling and its interpretation, focusing on topographic and spatial data analysis techniques.

2 To equip students with the skills to apply GIS models and spatial decision-support systems for thematic analysis using advanced tools such as MCDM and AHP.

3 To familiarize students with open-source geospatial modeling software and visualization techniques, including raster, vector, and 3D GIS applications.

Course outcomes: At the end of the course, students will be able to

1 Perform vector and raster data analysis, identify and correct geospatial data errors, and utilize geodatabases for spatial modeling.

2 Acquire proficiency in spatial modeling techniques, including regression methods (OLS, GWR), weighted overlay analysis, and network analysis, for solving real-world problems.

3 Use open-source GIS tools and visualization methods, such as contour mapping, hill shading, and 3D animations, to support decision-making in thematic areas like utility mapping and resource management.

Syllabus Contents:

- Introduction to geospatial modeling and interpretation,
- Applications of GIS models, Case Exercise. Topographic Analysis,
- Vector data Analysis. Spatial Modeling, Spatial Data Editing (Errors in Geospatial Data, Topological Editing, Concept of Geodatabase).
- Raster/GRID data analysis and Visualization techniques (Hill shades, Contour, Fly through generation/animation,
- Network Analysis, Utility mapping,
- Spatial Modeling (Regression: OLS, GWR, Weighted Overlay), 3D GIS, Spatial Decision Support System and thematic areas (Application of MCDM/AHP in spatial modeling).
- Introduction to various open source modelling software and tool.

References:

- Burrough, P.A. and McDonnell, R.A., 1998: Principles of Geographic Information System, Oxford University Press, Oxford.
- A.M. Chandra and S.K. Ghosh 2000. Remote Sensing and GIS. Narosa Publishing House, New Delhi.

Subject:	**Water Resources System Analysis**	**Credits**			
Type:	Program Elective (III)	L	T	P	Total
Teaching Scheme:	Lectures: 3 hours/week	3	0	0	3

Course Objectives: The course is aimed

1 To introduce the concept of systems and the need for a systems approach in water resources management, emphasizing steps in system design and problem formulation.

2 To provide knowledge of various optimization techniques, including Linear Programming (LP), Non-Linear Programming (NLP), and dynamic programming, for solving time- and space-based allocation problems.

3 To apply advanced optimization and simulation techniques to the design and operation of single and multipurpose reservoirs and river basin systems.

Course outcomes: At the end of the course, students will be able to

1 Understand the principles of systems analysis and optimization, enabling them to formulate and solve real-world problems using LP, NLP, and dynamic programming techniques.

2 Develop skills in applying advanced optimization techniques to the efficient design and operation of multipurpose reservoirs and river basin systems through case studies.

3 Gain proficiency in simulation-based analysis for water resource systems, with the ability to evaluate simplified and complex scenarios in reservoir operations and basin planning.

Syllabus Contents:

- Concept of a system need for systems approach, steps in systems design, assumptions,
- Problem formulation and solution by different optimization techniques: LP, NLP and dynamic programming techniques,
- One dimensional and multi-dimensional allocation process - optimization in time and space.
- Application of latest and advanced optimization techniques to design and operation of single and multipurpose reservoirs.
- Linear and Non-linear case studies.
- Analysis by simulation- simple examples of single and multipurpose reservoirs and simplified river basin systems. Case studies.

References:

- Vedula, S. Mujumdar, P. P. Water Resources Systems, Modelling Techniques and Analysis, Tata McGraw-Hill. 2005.
- Hall, Warren, A, and A. Dracup, Water Resources Systems Engineering, Tata McGrah-Hill Pub. Co. Ltd., 1970.
- Maass, A., M.M. Hufschmidt, R. Dorfman, H. A., Thomas, Jr., S.A. Marglin and G.M. Fair, Design of Water Resources Systems, Harvard University Press, Cambridge, Mass., 1962
- Helweg, Otto, J., Water Resources Planning and Management, John Wiely and Sons, 1985.
- Hiller, P.S. and G.I. Lieberman, Operations research, Holden-day Inc., 1974.
- Loucks Daniel, P., Jery R. Stedinger and Douglas A. Haith, Water Resources System Planning and Analysis, Prentice Hall, Inc. Englewood cliffs, New Jersey, 1981.

Subject:	**Physico-chemical and biological Process Laboratory**	**Credits**			
Type:	Core Lab (I)	L	T	P	Total
Teaching Scheme:	Lectures: 2 hours/week	0	0	4	2

Course Objectives: The course is aimed

1 To provide `hand in experience how to analyse different physical, chemical and biological processes in water and wastewater treatment systems.

Course outcomes: At the end of the Lab, students will be able to

1 Know about working principles and analysis of different physical unit operations carried out in water and wastewater treatment
2 Know about working principles and analysis of different chemical unit operations carried out in water and wastewater treatment
3 Know about working principles and analysis of different biological unit operations carried out in water and wastewater treatment

List of Experiments/Assignments:

- Determination of optimum coagulant for removal of turbidity
- Determination of chlorine dose for disinfection of surface water
- Determination of phenol from wastewater
- Adsorption of phenol on activated carbon and isotherm analysis
- Degradation study of organic compounds through oxidation process
- Determination of solids in wastewater
- Determination of biochemical oxygen demand of wastewater
- Determination of chemical oxygen demand of wastewater
- Determination of oil and grease from wastewater

References:

- Standard Methods for the Examination of water and Wastewater, APHA, AWWA,WEF.

Subject:	**Research Methodology and IPR**	**Credits**			
Type:	MLR	L	T	P	Total
Teaching Scheme:	Lectures: 2 hours/week	2	0	0	2

Course Objectives: The course is aimed

1 To understand the research problem formulation.

2 To study and analyze the research related information

3 To learn the research ethics, implement IR and understanding research problems

Course outcomes: At the end of the course, students will be able to

1 Understand research problem formulation for implementtion.

2 Analyze the research related information and summarize the results

3 Learn and Follow the research ethics

4 Understanding that when IPR would take such important place in growth of individuals & nation, it is needless to emphasis the need of information about Intellectual Property

5 Right to be promoted among students in general & engineering in particular.

6 Understand research problem formulation.

Syllabus Contents:

- **Introduction and Design of research**: Meaning, objectives and significance of research, types and parameters of research, research process, identification and definition of the research problem, definition of construct and variables, pure and applied research design, exploratory and descriptive design methodology, qualitative vs. quantitative research methodology, field studies, field experiments vs. laboratory experiments, research design in social and physical sciences.

- **Data and Methods of Data Collection**: Survey, assessment and analysis: data collection, primary and secondary sources of data, Collection of primary data through questionnaire and schedules. Collection of secondary data, processing and analysis of data. Sample survey, simple random sampling, stratified random sampling, systematic sampling, cluster sampling, area sampling and multistage sampling. Pilot survey, scaling techniques, validity & reliability.

- **Data Analysis:** Procedure for testing of hypothesis, the null hypothesis, determining levels of significance, type i and ii errors, grouped data distribution, measures of central tendency, measures of spread/dispersion, normal distribution, analysis of variance: one way, two-way, chi square test and its application, students 'T' distribution, non-parametric statistical techniques, binomial test. Correlation and regression analysis – discriminate analysis – factor analysis – cluster analysis, measures of relationship

- Research report preparation and presentation: Review of literature: historical survey and its necessity, layout of research plan, meaning, techniques and precautions of interpretation, types of report: technical report, popular report, report writing – layout of research report, mechanics of writing a research report. Writing bibliography and references.

- Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

References:

- Research in education, By J W Best and J V Kahn, Pearson/ Allyn and Bacon.
- Research Methodology – Methods and Techniques, C K Kothari, New Age International.
- Design and Analysis of Experiments, D C Montgomery, Wiley.
- Applied Statistics & Probability for Engineers, D C Montgomery & G C Runger, Wiley.
- Management Research Methodology: Integration of Principles, Methods and Techniques, K N Krishnaswamy, A I Sivakumar and M Mathiranjan, Pearson Education.

Semester-II

Subject:	**Solid and Hazardous Waste Management**			**Credits**	
Type:	Core (III)	L	T	P	Total
Teaching Scheme:	Lectures: 3 hours/week	3	0	0	3

Course objective: The course is aimed

1. To provide the students with basic understanding about the generation of solid wastes, its minimization and treatment methods and management for its safe disposal

Course outcomes: At the end of the course, students will be able to

1 Understand the sources and composition of different solid and hazardous wastes

2 Know about the different methods for waste treatment and management

3 Acquire knowledge about the waste composition and treatment methods for specific industries.

4 Know about solid waste risk assessment, remedial measures and legal framework.

Syllabus Contents:

- **Introduction:** Definition, Solid waste classification, Characteristics, Sources, -Solid waste management–Overviews of solid waste quantity, onsite handling and generation of solid waste; collection, Processing, storage, including segregation; Transfer and transport-route layout; Processing and Disposal.
- **Ultimate Disposal of Municipal Solid Waste:** Sanitary Landfill-criteria for landfill, landfill stability and operational procedure, gas and leachate control, Composting-aerobic and anaerobic, vermi-compost, Incineration; Biomedical Waste, e-waste management
- **Resource and Energy recovery form solid waste:** Processing and separation of components, recovery systems, system design and layout, energy recovery from aerobic and anaerobic digestion, incineration, combustion and energy recovery, gasification, pyrolysis, energy recovery system and system efficiency
- **Hazardous waste:** Definition and episodes, Sources and types, Classification and testing-EP Toxicity Test, TCLP, Future endeavours.
- **Physical and chemical properties:** Solubility, Vapour pressure, diffusion, portioning: Octanol-water, soil-water, bio-concentration factor
- **Fate and contaminant transport:** ground water flow and contaminant transport, factors affect groundwater contaminants transport, Hazardous waste removal mechanism and site remediation techniques
- Quantitative risk assessment, remedial measures, Laws and environmental ethics, legal framework

References:

- H.S. Peavy, D.R.Rowe and G. Tchobanoglous. Environmental Engineering. McGraw-Hill
- M.D. LaGrega, P.L.Buckinghum, J.C. Evans and Environmental Resources Management, Hazardous Waste Management,McGraw-Hill
- S.C. Bhatia. Environmental Pollution and Control in Chemical Process Industries, Khanna Publishers

Subject:	**Open Channel Hydraulics**	**Credits**			
Type:	Core (IV)	L	T	P	Total
Teaching Scheme:	Lectures: 3 hours/week	3	0	0	3

Course Objectives: The course is aimed

1 To introduce students to the fundamental concepts of hydraulics, including open channel flow, uniform and critical flow, and energy and momentum principles.

2 To equip students with the knowledge and skills to analyze and compute normal and critical depth, channel control, and flow resistance in various types of channels.

3 To provide an understanding of unsteady flow dynamics, including the Saint-Venant equations, wave propagation, and surge, with practical applications like the dam-break problem and flow in channel bends.

Course outcomes: At the end of the course, students will be able to

1 Understand and apply the principles of open channel flow, including the calculation of normal and critical depth and the analysis of uniform, supercritical, and gradually varied flow.

2 Develop the ability to measure velocity, estimate discharge, and develop rating curves using hydrometric methods.

3 Solve unsteady flow problems, applying Saint-Venant equations, and analyze complex flow situations such as wave propagation, surge, and the dam-break scenario.

Syllabus Contents:

- Review of Fundamentals of Hydraulics, Introduction to open channel flow, basic features, uniform flow, critical flow, computing normal and critical depth,
- Energy and momentum of flow, channel control and transitions, uniform flow and flow resistance, composite roughness and compound channels,
- Gradually varied flow, classifications and computations of free surface profiles, spatially varied flow, supercritical flows and oblique flows, rapidly varied flow, hydraulic jump
- Hydrometry velocity measurements, discharge estimation methods and rating curve development methods ;
- Unsteady flow: Saint-Venant equation of continuity and momentum equations of motion, wave propagation and surge, method of characteristics, dam-break problem, flow in channel bends.

References:

- Chow, V.T., Open Channel Hydraulics, McGraw-Hill, Tokyo, 1959.
- Subramanya K., Flow in Open Channels, Tata McGraw-Hill, 1986.
- Chaudhary, H., Open Channel Flow, Springer.
- Mahmood, K. and Yevjevich, V., Unsteady flow in Open Channels, Water Resources Publications, Fort Collins, 1975.
- Ranga Raju, K.G., Flow through Open Channels
- Henderson, open Channel Flow, Mac Millian series in Civil Engg. Inc.
- Ralph A. Wurbs, Wesley P. James, Water Resources Engineering, Prentice-Hall of India Pvt. Ltd. New Delhi.

Subject:	**Process and Hydraulic Design of Water and Wastewater Systems**			**Credits**	
Type:	Program Elective (IV)	L	T	P	Total
Teaching Scheme:	Lectures: 3 hours/week	3	0	0	3

Course objective: **The course is aimed**

1 To familiarize the students about various design aspects and considerations for water and wastewater treatment units, and to learn about the hydraulics of water and wastewater treatment plant and water distribution system and sewerage system.

Course outcomes: **At the end of the course, students will be able to**

1 Students will be able to learn and design different unit processes for water and wastewater treatment

2 Students will be able to design intake structures, wells, water distribution system and sewerage system.

3 Students will be able to design the hydraulic profiles in water and wastewater treatment plants.

Syllabus Contents:

- **Estimation of water and wastewater flow:** Various types of water demand; Design Period; Population forecasting; Variation in rate of demand; Estimation of sewage quantity – rational method
- **Hydraulics of wells:** Geological formation - aquifer, aquitard, aquiclude and aquifuge; Storage Coefficient; Specific yield; Coefficient of permeability; Coefficient of transmissibility; Well Hydraulics – steady flow analysis and unsteady flow analysis; Unconfined steady flow into an infiltration gallery.
- **Hydraulics of water supply system:** Methods of distributionofwater; Distribution reservoirs and its capacity; Layout of distribution system; Hydraulics of conduits – major and minor losses; Hazen-Williams formula; Darcy-Weisbach formula;Analysis of pipe network – Equivalent pipe method and Hardy Cross method
- **Hydraulics of sewer and its design:** Systems of sewerage andtheir lay-outs; Patterns of sewerage lay-out; Sewer materials;Type of flow; Flow friction formulae - Manning's formula;Design of circular sewers; Proportional hydraulic elements;Hydraulic elements of circular sewer running partially full;Design examples; Design guidelines
  Design of unit operations and process: Design of unitprocess/operations for water treatment and wastewatertreatmentunits as per CPHEEO manual.

References:

- Metcalf & Eddy “Wastewater Engineering –Treatment and Reuse”, Tata McGraw Hill Publishers.
- Davis andCornwel, “Introduction to Environmental Engineering”, McGraw Hill Publishers
- Peavy, Rowe and Tchobanoglous, “Environmental Engineering”, McGraw Hill Publishers
- Garg, S. K. “Environmental Engineering (Vol I & II)’’, Khanna Publisher
- CPHEEO manual on water supply and treatment and CPHEEO manual on sewerage and sewage treatment

Subject:	**Applied Hydrology**	**Credits**			
Type:	Program Elective (IV)	L	T	P	Total
Teaching Scheme:	Lectures: 3 hours/week	3	0	0	3

Course Objectives: The course is aimed

1 To provide foundational knowledge of hydrology, atmospheric processes, and their relationship to precipitation, evaporation, and evapotranspiration.
2 To equip students with skills for analyzing hydrologic data, including precipitation measurement, hydrograph analysis, and probability-based risk assessment for hydraulic design.
3 To introduce advanced hydrologic concepts such as flood routing, real-time forecasting, urban hydrology, and time series analysis for effective water resource management.

Course outcomes: At the end of the course, students will be able to

1 Students will understand the basic principles of hydrology, including atmospheric composition, temperature variations, humidity, and precipitation processes, and their measurement techniques.
2 Students will be able to perform hydrograph analysis, assess risk and uncertainty in hydrologic design, and apply flood routing methods to real-world scenarios.
3 Students will develop the ability to forecast hydrologic events in real-time, analyze urban hydrology challenges, and use time series analysis for modeling and decision-making.

Syllabus Contents:

- Basic concepts of hydrology; structure and composition of atmosphere, air mass, cold and warm fronts;
- Atmospheric temperature and it variations; vapor pressure and relative humidity; evaporation and evapo-transpiration;
- Types and forms of precipitation; measurement of precipitation and other atmospheric parameters; hydrograph analysis;
- Probability, risk and uncertainty analysis for hydrologic and hydraulic design;
- Flood routing –hydrologic and hydraulic routing
- Developing algorithms; hydrologic real time forecasting;
- Urban hydrology; time series analysis.

References:

- Chow, V.T., Maidment, D.R., Mays, L.W., Applied Hydrology, McGraw Hill, 1988.
- Dingman L. S. (2002), “Physical Hydrology”, 2 Ed. Waveland Press, Inc., USA
- Viessman, W. Jr. And G. L. Lewis (2003), Introduction to Hydrology, 5 Edition, Pearson
- Hann C.T. (1995), “Statistical Methods in Hydrology”, First East-West Press Edition, New Delhi.
- Box, G. E. P., G. M. Jenkins, and G. C. Reinsel (2003), “Time Series Analysis, Forecasting and Control”, Pearson Education, Singapore

Subject:	**Flood Estimation and Control**	**Credits**			
Type:	Program Elective (IV)	L	T	P	Total
Teaching Scheme:	Lectures: 3 hours/week	3	0	0	3

Course Objectives: The course is aimed

1 To provide an in-depth understanding of floods, including their types, causes, and various methods for flood estimation and frequency analysis.
2 To equip students with knowledge of flood routing techniques, design flood estimation methods, and guidelines for infrastructure design based on Indian standards and CWC recommendations.
3 To explore structural and non-structural flood control measures, flood forecasting, and management strategies for urban and multipurpose projects.

Course outcomes: At the end of the course, students will be able to

1 Students will be able to classify and analyze different types of floods, apply methods for estimating flood magnitudes, and perform frequency analysis using annual and PoT series.
2 Students will gain proficiency in flood routing techniques such as hydrological, kinematic, diffusion, and hydraulic methods, including the use of two-dimensional routing models.
3 Students will develop skills to design flood control strategies, implement flood forecasting and warning systems, and manage urban flood challenges through structural and non-structural measures.

Syllabus Contents:

- Floods and its types cause of floods, various methods of estimating floods, flood frequency analysis: assumptions,
- Frequency analysis of annual and PoT series, deterministic methods, depth-area-duration curves,
- Flood from small catchments, flood routing, detailed study of hydrological,
- Kinematic, diffusion and hydraulic routing methods, two dimensional routing models,
- Design flood estimation methods: Standard Project Flood and Probable Maximum Flood,
- Indian standard and CWC guidelines for design flood estimation for different structures,
- Various methods of flood control including structural and non-structural measures such as embankments, diversion, floodplain zone flood forecasting and flood warning,
- Flood fighting and urban floods single and multi-purpose projects,

References:

- Chow, V.T., (Ed), Handbook of Applied Hydrology, McGraw-Hill, 1964.
- Linsley, Ray. K. and Franzini, Joseph. B., Water Resources Engineering, McGraw-Hill, 1972.
- Chow. V.T., Maidment, D.R. and Mays, L.W., Applied Hydrology, McGraw-Hill, 1988.
- Stephenson, D., Stormwater Hydrology and drainage, Elsevier Scientific Publishing Company, 1981.

Subject:	**Advance Hydraulic Engineering**	**Credits**			
Type:	Program Elective (V)	L	T	P	Total
Teaching Scheme:	Lectures: 3 hours/week	3	0	0	3

Course Objectives: The course is aimed

1 To impart a comprehensive understanding of open channel hydraulics, including uniform, critical, and gradually varied flow (GVF) with applications to compound channels.

2 To familiarize students with channel design principles, sediment transport, silt theories, and river mechanics, focusing on erosion control and river training works.

3 To introduce the fundamentals of dam engineering, hydraulic modeling, and the environmental considerations associated with hydraulic structures.

Course outcomes: At the end of the course, students will be able to

1 Students will be able to analyze and apply concepts of open channel flow, including GVF and rapidly varied flow, in the design and evaluation of prismatic and non-prismatic channels.

2 Students will develop proficiency in designing erodible and non-erodible channels, understanding sediment transport processes, and implementing river training and erosion control measures.

3 Students will understand the principles of dam engineering and hydraulic modeling, along with the ability to assess environmental impacts related to hydraulic structures.

Syllabus Contents:

- Open channel hydraulics, uniform flow, critical flow
- GVF with special reference to compound channel,
- Rapidly varied flow in prismatic and non-prismatic channel
- Channel design- erodible and non-erodible channels,
- Silt theories, sediment transport; river mechanics, river erosion,
- River training works; dam engineering and related environmental issues;
- Concept of hydraulic models.

References:

- Ranga Raju, K.G., Flow through Open Channel, Tata McGraw Hill, New Delhi,1996.
- Chow, V.T, Open Channel Hydraulics, McGraw Hill, New York, 1959.
- Hendersen, F.M., Open Channel Flow, McGraw Hill, New York, 1966.

Subject: **Spatial Data Collection and Analysis**

		Credits			
Type:	Program Elective (V)	L	T	P	Total
Teaching Scheme:	Lectures: 3 hours/week	3	0	0	3

Course Objectives: The course is aimed

1. To introduce students to the fundamentals of map reading, cartographic techniques, and thematic mapping using various map projections and coordinate systems.
2. To provide an understanding of remote sensing principles, sensor types, and image processing techniques for environmental and resource mapping.
3. To familiarize students with Global Positioning Systems (GPS) and advanced spatial data collection methods, including laser-based techniques.

Course outcomes: At the end of the course, students will be able to

1. Students will be able to interpret various types of maps, understand coordinate systems and projections, and prepare base maps and thematic maps for diverse applications.
2. Students will gain proficiency in remote sensing techniques, including aerial and satellite image interpretation, digital image correction, enhancement, and classification methods.
3. Students will develop skills in GPS field operations, data collection, and integration with GIS for resource mapping and environmental monitoring using advanced spatial data collection tools

Syllabus Contents:

- Basics of map reading, types and sources of map, cartographic representation of data, map coordinate system, projections and their types, and guidelines for preparing a base map, thematic mapping.
- Aerial photographs, Mosaic, Image interpretation - Elements and methods, Stereo-model.
- Physics of remote sensing: Electro-magnetic spectrum and spectral signatures, Types of remote sensing, Platforms and sensors; active and passive sensors; aerial photographs, satellite images,
- Radars; sensor characteristics, Resolution- spatial, spectral, radiometric and temporal, Image interpretation - Elements and methods, Image correction–geometric, Digital image enhancement techniques (stretching, filtering), Classification: supervised and unsupervised,
- Application of remote sensing techniques in resource and environment mapping, monitoring case studies.
- Introduction to Microwave remote sensing
- Global Positioning Systems (GPS): Introduction to the GPS functions,
- Field operation of GPS and data collection using GPS, Basic concepts and components of GIS,
- Introduction of laser based spatial data collection techniques.

References:

- Jensen, J. R., “Introductory digital image processing: a remote sensing perspective.” Prentice
- Hall
- Lillesand, T.M., and Keifer, R.W . “Remote Sensing and DIP.” John Wiley & Sons, Inc.
- Lillian, Thomas M (2003), “Remote sensing and image interpretation.” John Wiley & Sons. New York
- Rao, G. S. “Global Navigation Satellite Systems (GNSS)” Tata McGraw hill Publications

Subject:	**Introduction to CFD**	**Credits**			
Type:	Program Elective (V)	L	T	P	Total
Teaching Scheme:	Lectures: 3 hours/week	3	0	0	3

Course Objectives: The course is aimed

1 To introduce the fundamentals of fluid flow, governing equations, and classification of partial differential equations (PDEs) with applications to fluid mechanics and heat transfer.

2 To equip students with knowledge of numerical methods such as finite difference and finite volume methods, including stability analysis, error estimation, and higher-order schemes.

3 To develop problem-solving skills in solving Navier-Stokes equations, grid generation, and uncertainty analysis, with emphasis on iterative and direct solution techniques.

Course outcomes: At the end of the course, students will be able to

1 Students will be able to classify and analyze PDEs as elliptic, parabolic, or hyperbolic and understand their role in fluid flow and energy equations.

2 Students will gain proficiency in applying finite difference and finite volume methods to discretize and solve complex fluid flow problems, including incompressible Navier-Stokes equations.

3 Students will develop the ability to perform grid generation, conduct uncertainty analyses, and ensure the accuracy of numerical results through grid independence, time-step, and domain studies.

Syllabus Contents:

- Introduction, Fluid flow, Governing equations, Classifications of PDE, Elliptic, Parabolic and
- Hyperbolic equations, Navier-Stokes (NS) and Energy equations,
- Explicit and implicit methods, Higher order schemes, Finite difference (FDM) and Finite volume (FVM) methods, Finite difference formulation,
- Various aspects of finite difference equation, Error and stability analysis, Modified equations;
- Solutions of simultaneous equations, Iterative and direct methods, TDMA, ADI, Incompressible flow,
- Solution of incompressible NS equation, Higher order discretization, Finite volume formulations,
- Flux splitting and upwinding, Grid generation, Uncertainty of numerical results,
- Sources of uncertainties, Independence studies on grid, time-step, domain and initial condition.

References:

- Anderson J. D., “Computational Fluid Dynamics: The Basics with Applications”, McGraw Hill.
- Chaudhry M. H., “Open Channel Flow”, Prentice -Hall.
- Chung T. J., “Computational Fluid Dynamics” , Cambridge University Press, 2003.
- Muralidhar K. and Sundararajan T., “Computational Fluid Flow and Heat Transfer”, Narosa Publisher, 2011.

Subject:	**Business Analytics**	**Credits**			
Type:	Open Elective	L	T	P	Total
Teaching Scheme:	Lectures: 3 hours/week	3	0	0	3

Course Objectives: The course is aimed

1 To introduce the aspects and importance of data analytics

2 To study the ability of think critically in making decisions based on data and deep analytics.

3 To learn the technical skills in predicative and prescriptive modeling to support business decision-making and to demonstrate the ability to translate data into clear, actionable insights

Course outcomes: At the end of the course, students will be able to

1 Students will demonstrate knowledge of data analytics

2 Students will demonstrate the ability of think critically in making decisions based on data and deep analytics.

3 Students will demonstrate the ability to use technical skills in predicative and prescriptive modeling to support business decision-making.

4 Students will demonstrate the ability to translate data into clear, actionable insights.

Syllabus Contents:

- Unit1: Business analytics: Overview of Business analytics, Scope of Business analytics, Business Analytics Process, Relationship of Business Analytics Process and organisation, competitive advantages of Business Analytics. Statistical Tools: Statistical Notation, Descriptive Statistical methods, Review of probability distribution and data modelling, sampling and estimation methods overview.
- Unit 2: Trendiness and Regression Analysis: Modelling Relationships and Trends in Data, simple Linear Regression. Important Resources, Business Analytics Personnel, Data and models for Business analytics, problem solving, Visualizing and Exploring Data, Business Analytics Technology.
- Organization Structures of Business analytics, Team management, Management Issues, Designing Information Policy, Outsourcing, Ensuring Data Quality, Measuring contribution of Business analytics, Managing Changes. Descriptive Analytics, predictive analytics, predicative Modelling, Predictive analytics analysis, Data Mining, Data Mining Methodologies, Prescriptive analytics and its step in the business analytics Process, Prescriptive Modelling, nonlinear Optimization.
- Forecasting Techniques: Qualitative and Judgmental Forecasting, Statistical Forecasting Models, Forecasting Models for Stationary Time Series, Forecasting Models for Time Series with a Linear Trend, Forecasting Time Series with Seasonality, Regression Forecasting with Casual Variables, Selecting Appropriate Forecasting Models. Monte Carlo Simulation and Risk Analysis: Monte Carle Simulation Using Analytic Solver Platform, New-Product Development Model, Newsvendor Model, Overbooking Model, Cash Budget Model.
- Unit 5: Decision Analysis: Formulating Decision Problems, Decision Strategies with the without Outcome Probabilities, Decision Trees, the Value of Information, Utility and Decision Making.
- Unit 6: Recent Trends in Embedded and collaborative business intelligence, Visual data recovery, Data Storytelling and Data journalism.

References:

- Business analytics Principles, Concepts, and Applications by Marc J. Schniederjans, Dara G. Schniederjans, Christopher M. Starkey, Pearson FT Press.
- Business Analytics by James Evans, persons Education..

Subject:	**Industrial Safety**	**Credits**			
Type:	Open Elective	L	T	P	Total
Teaching Scheme:	Lectures: 3 hours/week	3	0	0	3

Course Objectives: The course is aimed

1 To study the Safety Measures and the plans for Engineering maintenance.

2 To learn the determination of the wear & Corrosion and apply methods for their prevention.

3 To introduce the method for Tracing the Fault and equipment, and preventive maintenance.

Course outcomes: At the end of the course, students will be able to

1 Apply the knowledge of Safety Measures

2 Plan for Engineering maintenance.

3 Determine the wear & Corrosion and apply methods for their prevention.

4 Trace the Fault of machine tools and equipment

5 Plan and implement the periodic and preventive maintenance for machines/equipment.

Syllabus Contents:

- Industrial safety: Accident, causes, types, results and control, mechanical and electricalhazards, types, causes and preventive steps/procedure, describe salient points of factories act 1948 for health and safety, wash rooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc, Safety color codes. Fire prevention and firefighting.
- Fundamentals of maintenance engineering: Definition and aim of maintenance engineering, Primary and secondary functions and responsibility of maintenance department, Types of maintenance, Types and applications of tools used for maintenance, Maintenance cost & its relation with replacement economy, Service life of equipment.
- Wear and Corrosion and their prevention: Wear- types, causes, effects, wear reduction methods, lubricants-types and applications, Lubrication methods, general sketch, working and applications, i. Screw down grease cup, ii. Pressure grease gun, iii. Splash lubrication, iv. Gravity lubrication, v. Wick feed lubrication vi. Side feed lubrication, vii. Ring lubrication, Definition, principle and factors affecting the corrosion. Types of corrosion, corrosion prevention methods.
- Fault tracing: Fault tracing-concept and importance, decision tree concept, need and applications, sequence of fault finding activities, show as decision tree, draw decision tree for problems in machine tools, hydraulic, pneumatic, automotive, thermal and electrical equipment's like, I. Any one machine tool, ii. Pump iii. Air compressor, iv. Internal combustion engine, v. Boiler, vi. Electrical motors, Types of faults in machine tools and their general causes.
- Periodic and preventive maintenance: Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance. Steps/procedure for periodic and preventive maintenance of: I. Machine tools, ii. Pumps, iii. Air compressors, iv. Diesel generating (DG) sets, Program and schedule of preventive maintenance of mechanical and electrical equipment, advantages of preventive maintenance. Repair cycle concept and importance

References:

- Maintenance Engineering Handbook, Higgins & Morrow, Da Information Services.
- Maintenance Engineering, H. P. Garg, S. Chand and Company.
- Pump-hydraulic Compressors, Audels, Mcgrew Hill Publication.
- Foundation Engineering Handbook, Winterkorn, Hans, Chapman & Hall London.

Subject:	**Operations Research**	**Credits**			
Type:	Open Elective	L	T	P	Total
Teaching Scheme:	Lectures: 3 hours/week	3	0	0	3

Course Objectives: The course is aimed

1 To study the dynamic programming for the solutions of discreet and continuous variables.

2 To learn the applications of non-linear programming

3 To introduce applications of the methods to carry out sensitivity analysis and implementation of real world problem simulations.

Course outcomes: At the end of the course, students will be able to

1 Apply the dynamic programming to solve problems of discreet and continuous variables.

2 Apply the concept of non-linear programming

3 Carry out sensitivity analysis

4 Model the real world problem and simulate it.

Syllabus Contents:

- Optimization Techniques, Model Formulation, models, General L.R Formulation, Simplex Techniques, Sensitivity Analysis, Inventory Control Models
- Formulation of a LPP - Graphical solution revised simplex method - duality theory - dual simplex method - sensitivity analysis - parametric programming
- Nonlinear programming problem - Kuhn-Tucker conditions min cost flow problem - max flow problem - CPM/PERT
- Scheduling and sequencing - single server and multiple server models - deterministic inventory models - Probabilistic inventory control models - Geometric Programming.
- Competitive Models, Single and Multi-channel Problems, Sequencing Models, Dynamic Programming, Flow in Networks, Elementary Graph Theory, Game Theory Simulation

References:

- H.A. Taha, Operations Research, An Introduction, PHI, 2008
- H.M. Wagner, Principles of Operations Research, PHI, Delhi, 1982.
- J.C. Pant, Introduction to Optimisation: Operations Research, Jain Brothers, Delhi, 2008
- Hitler Libermann Operations Research: McGraw Hill Pub. 2009
- Pannerselvam, Operations Research: Prentice Hall of India 2010
- Harvey M Wagner, Principles of Operations Research: Prentice Hall of India 2010

Subject:	**Cost Management of Engineering Projects**	**Credits**			
Type:	Open Elective	L	T	P	Total
Teaching Scheme:	Lectures: 3 hours/week	3	0	0	3

Course Objectives: The course is aimed

1 To learn the cost concepts in the cost management process.

2 To study the application of project cost control methods and determine costing and carryout the analysis of pricings for profitability.

3 To implement the application of PERT/CPM for cost management

Course outcomes: At the end of the course, students will be able to

1 Discuss the cost concepts in the cost management process.

2 Able to handle the projects by the application of project cost control methods.

3 Determine all types of costing and carryout the analysis of pricings for profitability.

4 Apply the PERT/CPM for cost management.

Syllabus Contents:

- Introduction and Overview of the Strategic Cost Management Process
- Cost concepts in decision-making; relevant cost, Differential cost, Incremental cost and Opportunity cost. Objectives of a Costing System; Inventory valuation; Creation of a Database for operational control; Provision of data for Decision-Making.
- Project: meaning, Different types, why to manage, cost overruns centres, various stages of project execution: conception to commissioning. Project execution as conglomeration of technical and non-technical activities. Detailed Engineering activities. Pre projectexecution main clearances and documents Project team: Role of each member. Importance Project site: Data required with significance. Project contracts. Types and contents. Project execution Project cost control. Bar charts and Network diagram. Project commissioning: mechanical and process
- Cost Behavior and Profit Planning Marginal Costing; Distinction between Marginal Costing and Absorption Costing; Break-even Analysis, Cost-Volume-Profit Analysis. Various decision-making problems. Standard Costing and Variance Analysis. Pricing strategies: Pareto Analysis. Target costing, Life Cycle Costing. Costing of service sector. Just-in-time approach, Material Requirement Planning, Enterprise Resource Planning, Total Quality Management and Theory of constraints. Activity-Based Cost Management, Bench Marking; Balanced Score Card and Value-Chain Analysis. Budgetary Control; Flexible Budgets; Performance budgets; Zero-based budgets. Measurement of Divisional profitability pricing decisions including transfer pricing.
- Quantitative techniques for cost management, Linear Programming, PERT/CPM, Transportation problems, Assignment problems, Simulation, Learning Curve Theory.

References:

- Cost Accounting A Managerial Emphasis, Prentice Hall of India, New Delhi
- Charles T. Horngren and George Foster, Advanced Management Accounting
- Robert S Kaplan Anthony A. Alkinson, Management & Cost Accounting
- Ashish K. Bhattacharya, Principles & Practices of Cost Accounting A. H. Wheeler publisher
- N.D. Vohra, Quantitative Techniques in Management, Tata McGraw Hill Book Co. Ltd.

Subject:	**Composite Materials**	**Credits**			
Type:	Open Elective	L	T	P	Total
Teaching Scheme:	Lectures: 3 hours/week	3	0	0	3

Course Objectives: The course is aimed

1 To study the implementation of the composite materials for the required performance and adopt the composite materials as reinforcements

2 To study the methods of manufacturing of metal matrix composites

3 To study the strength of laminates

Course outcomes: At the end of the course, students will be able to

1 Explain and also implement the composite materials for the required performance based on the characteristics.

2 Adopt the composite materials as reinforcements.

3 Implement the methods of manufacturing of metal matrix composites

4 Adopt the methods of manufacturing of polymer matrix composites

5 Evaluate the strength of laminates.

Syllabus Contents:

- INTRODUCTION: Definition – Classification and characteristics of Composite materials. Advantages and application of composites. Functional requirements of reinforcement and matrix. Effect of reinforcement (size, shape, distribution, volume fraction) on overall composite performance.
- REINFORCEMENTS: Preparation-layup, curing, properties and applications of glass fibers, carbon fibers, Kevlar fibers and Boron fibers. Properties and applications of whiskers, particle reinforcements. Mechanical Behavior of composites: Rule of mixtures, Inverse rule of mixtures. Isostrain and Isostress conditions.
- Manufacturing of Metal Matrix Composites: Casting – Solid State diffusion technique, Cladding – Hot isostatic pressing. Properties and applications. Manufacturing of Ceramic Matrix Composites: Liquid Metal Infiltration – Liquid phase sintering. Manufacturing of Carbon – Carbon composites: Knitting, Braiding, Weaving. Properties and applications.
- Manufacturing of Polymer Matrix Composites: Preparation of Moulding compounds and prepregs – hand layup method – Autoclave method – Filament winding method – Compression moulding – Reaction injection moulding. Properties and applications.
- Strength: Laminar Failure Criteria-strength ratio, maximum stress criteria, maximum strain criteria, interacting failure criteria, hygrothermal failure. Laminate first play failure-insight strength; Laminate strength-ply discount truncated maximum strain criterion; strength design using caplet plots; stress concentrations

References:

- Material Science and Technology – Vol 13 – Composites by R. W. Cahn – VCH, West Germany.
- Materials Science and Engineering, An introduction. WD Callister, Jr., Adapted by R. Balasubramaniam, John Wiley & Sons, NY, Indian edition, 2007.
- Hand Book of Composite Materials-ed-Lubin.
- Composite Materials – K.K.Chawla.
- Composite Materials Science and Applications – Deborah D.L. Chung.
- Composite Materials Design and Applications – Danial Gay, Suong V. Hoa, and Stephen W. Tasi.

Subject:	**Waste to Energy**	**Credits**			
Type:	Open Elective	L	T	P	Total
Teaching Scheme:	Lectures: 3 hours/week	3	0	0	3

Course Objectives: The course is aimed

1 To learn the Classifications of the waste for fuel and identify the devices for conversion of waste to energy.

2 To study and Implement the Biomass Pyrolysis and evaluate the methods of Biomass Gasification and implement their applications.

3 To study the designs, construction and operation the Biomass Combustion devices

Course outcomes: At the end of the course, students will be able to

1 Classify the waste for fuel and identify the devices for conversion of waste to energy.

2 Implement the Biomass Pyrolysis

3 Evaluate the methods of Biomass Gasification and implement their applications.

4 To design, construct and operation the Biomass Combustion devices.

5 Classify biomass, apply the bio energy systems design and construction.

Syllabus Contents:

- Introduction to Energy from Waste: Classification of waste as fuel – Agro based, Forest residue, Industrial waste - MSW – Conversion devices – Incinerators, gasifiers, digestors
- Biomass Pyrolysis: Pyrolysis – Types, slow, fast – Manufacture of charcoal – Methods - Yields and application – Manufacture of pyrolytic oils and gases, yields and applications.
- Biomass Gasification: Gasifiers – Fixed bed system – Downdraft and updraft gasifiers – Fluidized bed gasifiers – Design, construction and operation – Gasifier burner arrangement for thermal heating – Gasifier engine arrangement and electrical power – Equilibrium and kinetic consideration in gasifier operation.
- Biomass Combustion: Biomass stoves – Improved chullahs, types, some exotic designs, fixed bed combustors, Types, inclined grate combustors, Fluidized bed combustors, Design, construction and operation - Operation of all the above biomass combustors.
- Biogas: Properties of biogas (Calorific value and composition) - Biogas plant technology and status - Bio energy system - Design and constructional features - Biomass resources and their classification - Biomass conversion processes - Thermo chemical conversion - Direct combustion - biomass gasification - pyrolysis and liquefaction - biochemical conversion - anaerobic digestion - Types of biogas Plants – Applications - Alcohol production from biomass - Bio diesel production - Urban waste to energy conversion - Biomass energy programme in India.

References:

- Non-Conventional Energy, Desai, Ashok V., Wiley Eastern Ltd., 1990.
- Biogas Technology - A Practical Hand Book - Khandelwal, K. C. and Mahdi, S. S., Vol. I & II, Tata McGraw Hill Publishing Co. Ltd., 1983.
- Food, Feed and Fuel from Biomass, Challal, D. S., IBH Publishing Co. Pvt. Ltd., 1991.
- Biomass Conversion and Technology, C. Y. WereKo-Brobby and E. B. Hagan, John Wiley & Sons, 1996.

Subject:	**Internet of Things**	**Credits**			
Type:	Open Elective	L	T	P	Total
Teaching Scheme:	Lectures: 3 hours/week	3	0	0	3

Course Objectives: The course is aimed

1 To introduce the concepts of Internet of Things.

2 To study the analysis of the basic protocols in wireless sensor network.

3 To learn the design of IoT applications in different domain and be able to analyze their performance and security.

Course outcomes: At the end of the course, students will be able to

1 Understand the concepts of Internet of Things.

2 Analyze basic protocols in wireless sensor network.

3 Design IoT applications in different domain and be able to analyze their performance

4 Elaborate the need for Data Analytics and Security in IoT

Syllabus Contents:

Introduction to Internet of Things

- Review of computer communication concepts (OSI layers, components, packet communication, Networks, TCP-IP, subnetting, IPV4 addressing and challenges). IPV6 addressing. IoT architecture reference layer. Characteristics IoT sensor nodes, Edge computer, cloud and peripheral cloud, single board computers, open source hardware, Examples of IoT infrastructure.
- **IoT and M2M**
  Software defined networks, network function virtualization, difference between SDN and NFV for IoT, Basics of IoT System Management with NETCOZF, YANG- NETCONF, YANG, SNMP NETOPEER
- **IOT protocols and Communication Technologies**
  MQTT, UDP, MQTT brokers, publish subscribe modes, HTTP, COAP,XMPP and gateway protocols, IoT Communication Pattern, IoT Protocol Architecture, Selection of Wireless technologies (6LoWPAN, Zigbee, WIFI, BT, BLE,SIG,NFC, LORA, Lifi, Widi).
- **Data and Analytics for IoT**
  An Introduction to Data Analytics for IoT, Machine Learning, Big Data Analytics Tools and Technology, Edge Streaming Analytics, Network Analytics, Securing IoT, A Brief History of IOT Security, Common Challenges in IOT Security, How IT and OT Security Practices and Systems Vary, Formal Risk Analysis Structures: OCTAVE and FAIR, The Phased Application of Security in an Operational Environment.
- **IoT Physical Devices and Endpoints**: Introduction to Arduino and Raspberry Pi- Installation, Interfaces (serial, SPI, I2C), Programming – Python program with Raspberry PI with focus on interfacing external gadgets, controlling output, reading input from pins.
- **IoT Physical Servers and Cloud Offerings**: Introduction to Cloud Storage models and communication APIs WebServer: Web server for IoT, Cloud for IoT, Python web application

framework Designing a RESTful web API.

- **IoT application and its Variants: Case studies:** IoT for smart cities, smart grid, health care, agriculture, smart meters.M2M, Web of things, Cellular IoT, Industrial IoT, Industry 4.0,IoT standards.

References:

- "Internet of Things - A Hands-on Approach", Arshdeep Bahga and Vijay Madisetti, Universities Press, 2015, ISBN: 9788173719547
- "Internet of Things", Srinivasa K G, CENGAGE Leaning India, 2017.
- " IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things", David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Robert Barton, Jerome Henry1stEdition, Pearson Education (Cisco Press Indian Reprint). (ISBN: 978-9386873743)
- "Getting Started with Raspberry Pi", Matt Richardson & Shawn Wallace, O'Reilly (SPD), 2014, ISBN: 9789350239759.
- "From Machine to Machine to Internet of Things", Jan Holler, Vlasios Tsiatsis, Catherine Mulligan, Stamatis Karnouskos, Stefan Avesand, David Boyle, Elsevier Publications, 2014.

Subject:	**Computer Application in Water Resources lab**	**Credits**			
Type:	Core Lab I(II)	L	T	P	Total
Teaching Scheme:	Lectures: 2 hours/week	0	0	3	2

Course Objectives: The course is aimed

1 To equip students with hands-on skills in GIS tools and coding languages like Python, R, and MATLAB for geospatial analysis, hydrological modeling, and solving spatial problems related to water resources management.

Course outcomes: At the end of the course, students will be able to

1 Students will develop the ability to use GIS and coding techniques for database management, georeferencing, flood/drought analysis, DEM-based terrain modeling, and predictive applications in water system optimization and site selection.

Syllabus Contents:

- Exercises in GIS, starting with a software demonstration and georeferencing of scanned images and datasets. Edit GIS databases, handle attribute data, and perform data retrieval based on attributes and location. Connectivity functions, Digital Elevation Models (DEMs), and their applications are also explored. Optimum site selection using GIS tools, integrating various techniques for spatial problem-solving

- Use of coding languages like Python, R, MATLAB, and others in water resources. It includes data analysis of hydrological datasets, hydrological modeling, and flood/drought frequency analysis. Applications also involve GIS integration for watershed analysis, optimization of water systems, water quality monitoring, and machine learning for prediction.

Subject:	**Mini Project**	**Credits**			
Type:	Core	L	T	P	Total
Teaching Scheme:	Practice 4 hours//week (Contact: 2 hours/week)	0	0	4	2

Course Objectives: The Mini Project is aimed

1 To Identify structural engineering problems reviewing available literature.

2 To Study different techniques used to analyze complex structural systems.

3 Work on the solutions given and present solution by using his/her technique applying Engineering principles.

Course outcomes: At the end of the course, students will be able to

1 Identify methods for structural engineering problems reviewing available literature.

2 Adopt different techniques used to analyze complex structural systems.

3 Propose solutions, or give solutions or present a solution by using his/her technique applying Engineering principles.

Syllabus Content:

- Mini Project will have mid semester presentation and end semester presentation. Mid semester presentation will include identification of the problem based on the literature review on the topic referring to latest literature available.
- End semester presentation should be done along with the report on identification of topic for the work and the methodology adopted involving scientific research, collection and analysis of data, determining solutions highlighting individuals' contribution.
- Continuous assessment of Mini Project at Mid Sem and End Sem will be monitored by the departmental committee.

Subject:	**English For Research Paper Writing**	**Credits**			
Type:	Audit/Value Added Course	L	T	P	Total
Teaching Scheme:	Lectures: 2 hours/week	2	0	0	2

Course Objectives: The course is aimed

1 To study, how to improve writing skills and level of readability.

2 To Learn about what to write in each section and the skills needed when writing a Title

3 To learn writing a good quality of paper at the very first-time submission

Course outcomes: At the end of the course, students will be able to

1 Understand that how to improve the writing skills and level of readability.

2 Learn about what to write in each section

3 Understand the skills needed when writing a Title

4 Ensure the good quality of paper at very first-time submission

Syllabus Contents:

- Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness
- Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticizing, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts. Introduction
- Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check
- Key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Ruseful phrases, how to ensure paper is as good as it could possibly be the first- time submissioneview of the Literature.
- skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions
- useful phrases, how to ensure paper is as good as it could possibly be the first- time submission

References:

- Goldbort R (2006) Writing for Science, Yale University Press (available on Google Books)
- Day R (2006) How to Write and Publish a Scientific Paper, Cambridge University Press
- Highman N (1998), Handbook of Writing for the Mathematical Sciences, SIAM. Highman'sbook .
- Adrian Wallwork , English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011

Subject:	**Disaster Management**	**Credits**			
Type:	Audit/Value Added Course	L	T	P	Total
Teaching Scheme:	Lectures: 2 hours/week	2	0	0	2

Course Objectives: The course is aimed

1 To attempt the understanding of key concepts in disaster risk reduction and humanitarian response.

2 To study the disaster risk reduction and humanitarian response policy and practice from multiple perspectives

3 To study the standards of humanitarian response and practical relevance in specific types of disasters and conflict situations

Course outcomes: At the end of the course, students will be able to

1 Learn to demonstrate a critical understanding of key concepts in disaster risk reduction and humanitarian response.

2 Critically evaluate disaster risk reduction and humanitarian response policy and practice from multiple perspectives

3 Develop an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations and understand the strengths and weaknesses of disaster management approaches

Syllabus Contents:

- Introduction Disaster: Definition, Factors and Significance; Difference between Hazard and Disaster; Natural and Manmade Disasters: Difference, Nature, Types and Magnitude.
- Repercussions of Disasters and Hazards: Economic Damage, Loss of Human and Animal Life, Destruction of Ecosystem. Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts and Famines, Landslides and Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks and Spills, Outbreaks of Disease and Epidemics, War and Conflicts.
- Disaster Prone Areas in India, Study of Seismic Zones; Areas Prone To Floods andDroughts, Landslides and Avalanches; Areas Prone to Cyclonic and Coastal Hazards with special reference to Tsunami; Post-Disaster Diseases and Epidemics.
- Disaster Preparedness and Management: Preparedness: Monitoring of Phenomena Triggering a Disaster or Hazard; Evaluation of Risk: Application of Remote Sensing, Data from Meteorological and other agencies, Media Reports: Governmental and Community Preparedness.
- Risk Assessment: Disaster Risk: Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. Techniques of Risk Assessment, Global Co- Operation in Risk Assessment and Warning, People's Participation in Risk Assessment. Strategies for Survival.
- Disaster Mitigation: Meaning, Concept and Strategies of Disaster Mitigation, Emerging Trends in Mitigation. Structural Mitigation and Non-Structural Mitigation, Programs of Disaster Mitigation in India.

References:

- R. Nishith, Singh AK, "Disaster Management in India: Perspectives, issues and strategies", New Royal book Company.
- Sahni, Pardeep Et. al. (Eds.)," Disaster Mitigation Experiences And Reflections", Prentice Hall of India, New Delhi.
- Goel S. L. , Disaster Administration and Management Text and Case Studies" ,Deep &Deep Publication Pvt. Ltd., New Delhi.

Subject:	**Constitution of India**	**Credits**			
Type:	Audit/Value Added Course	L	T	P	Total
Teaching Scheme:	Lectures: 2 hours/week	2	0	0	2

Course Objectives: The course is aimed

1 To bring awareness of the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.

2 To know the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.

3 To remind the circumstances surrounding the foundation of the Congress Socialist Party and the eventual failure of the proposal of direct elections.

Course outcomes: At the end of the course, students will be able to

1 Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.

2 Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.

3 Discuss the circumstances surrounding the foundation of the Congress Socialist Party [CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal ofdirect elections through adult suffrage in the Indian Constitution.

4 Discuss the passage of the Hindu Code Bill of 1956.

Syllabus Contents:

- History of Making of the Indian Constitution: History Drafting Committee, (Composition & Working). Philosophy of the Indian Constitution: Preamble, Salient Features
- Contours of Constitutional Rights & Duties: Fundamental Rights, Right to Equality, Right to Freedom, Right against Exploitation, Right to Freedom of Religion, Cultural and Educational Rights, Right to Constitutional Remedies, Directive Principles of State Policy, Fundamental Duties.
- Organs of Governance: Parliament, Composition, Qualifications and Disqualifications, Powers and Functions, Executive, President, Governor, Council of Ministers, Judiciary, appointment and Transfer of Judges, Qualifications, Powers and Functions.
- Local Administration: District's Administration head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation. Pachayati raj: Introduction, PRI: ZilaPachayat. Elected officials and their roles, CEO ZilaPachayat: Position and role. Block level: Organizational Hierarchy (Different departments), Village level: Role of Elected and Appointed officials, Importanceof grass root democracy.
- Election Commission: Election Commission: Role and Functioning, Chief Election Commissioner and Election Commissioners, State Election Commission: Role and Functioning, Institute and Bodies for the welfare of SC/ST/OBC and women.

References:

- The Constitution of India, 1950 (Bare Act), Government Publication.
- Dr. S. N. Busi, Dr. B. R. Ambedkar framing of Indian Constitution, 1st Edition, 2015.
- M. P. Jain, Indian Constitution Law, 7th Edn., Lexis Nexis, 2014.
- D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015.

Subject:	**Stress Management by Yoga**	**Credits**			
Type:	Audit/Value Added Course	L	T	P	Total
Teaching Scheme:	Lectures: 2 hours/week	2	0	0	2

Course Objectives: The course is aimed

1 To introduce the practices for developing a healthy mind in a healthy body.

2 To practice the methods for improving human efficiency at work

Course outcomes: At the end of the course, students will be able to

1 Develop healthy mind in a healthy body thus improving social health also.

2 Improve efficiency

Syllabus Contents:

- Definitions of Eight parts of yog. (Ashtanga).
- Yam and Niyam, Do`s and Don't's in life, i) Ahinsa, satya, astheya, bramhacharya and aparigraha, ii) Shaucha, santosh, tapa, swadhyay, ishwarpranidhan.
- Asan and Pranayam, i) Various yog poses and their benefits for mind & body, ii) Regularization of breathing techniques and its effects-Types of pranayam.

References:

- 'Yogic Asanas for Group Tarining-Part-I" :Janardan Swami Yogabhyasi Mandal, Nagpur
- "Rajayoga or conquering the Internal Nature" by Swami Vivekananda, Advaita Ashrama (Publication Department), Kolkata.

Semester-III

Subject:	**Dissertation I**	**Credits**			
Type:	Core	L	T	P	Total
Teaching Scheme:	Practice hours: 28 hours/week (contact-3 hours/week)	0	0	28	14

Course Objectives: The course is aimed

1 To inculcate the reviewing available research literature for Identifying the complex Civil Engineering problems.

2 To practice the applications of appropriate techniques to analyze complex Civil Engineering problems.

3 To adopt the engineering and management principles through efficient handling of the projects

Course outcomes: At the end of the course, students will be able to

1 Identify complex Civil Engineering problems reviewing available literature.

2 Identify appropriate techniques to analyze complex Civil Engineering problems.

3 Apply engineering and management principles through efficient handling of project

Syllabus Contents:

- Dissertation-I will have mid semester presentation and end semester presentation. Mid semester presentation will include identification of the problem based on the literature review on the topic referring to latest literature available.
- End semester presentation should be done along with the report on identification of topic for the work and the methodology adopted involving scientific research, collection and analysis of data, determining solutions and must bring out individuals contribution.
- Continuous assessment of Dissertation – I and Dissertation – II at Mid Sem. and End Sem. will be monitored by the departmental committee.

Semester-IV

Subject:	**Dissertation-II**	**Credits**			
Type:	Core	L	T	P	Total
Teaching Scheme:	Practice hours: 32 hours/week (contact-3 hours/week)	0	0	32	16

Course Objectives: The dissertation is aimed

1 To introduce the problem solving skills related to the complex Civil Engineering problems by applying appropriate techniques and tools.

2 To necessitate the exhibition of good communication skill to the engineering community and society.

3 To crop out and demonstrate the promotion of professional ethics and work culture.

Course outcomes: At the end of the Dissertation, students will be able to

1 Solve complex Civil Engineering problems by applying appropriate techniques and tools.

2 Exhibit good communication skill to the engineering community and society.

3 Demonstrate professional ethics and work culture.

Syllabus Contents:

- Dissertation – II will be extension of the work on the topic identified in Dissertation – I.
- Continuous assessment should be done of the work done by adopting the methodology decided involving numerical analysis/ conduct experiments, collection and analysis of data, etc. There will be pre-submission seminar at the end of academic term. After the approval the student has to submit the detail report and external examiner is called for the viva-voce to assess along with guide.